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CYCLIST BUNCH RIDING: A REVIEW OF THE LITERATURE

by

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Abstract:

This report is a review of the literature on cyclists who ride in large groups or bunches on public roads. The research was conducted following the Victorian State Coroner's investigation into the death of an elderly pedestrian, following a collision with a cyclist who was riding in a bunch. The aims of the review were to understand the behaviour of bunch riders, particularly the behaviours that may contribute to increased risk of collision and to make recommendations for effective enforcement and countermeasure strategies for this road user group. Due to the paucity of published literature on bunch riding, the review was expanded to include other relevant cycling literature. In addition, footage of bunch riding from Victoria Police, recorded in 2005 and 2007 was analysed and the behaviour of cyclists was found to have differed considerably. Based on the findings of this review, some broad suggestions for enforcement and education are made to improve the safety of bunch cyclists. Furthermore, there is a clear need for further research to address the safety concerns of bunch riding and a number of specific research recommendations are made.

Key Words:
Bunch riding, cyclist, safety, crashes, countermeasures

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Preface

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EXECUTIVE SUMMARY

The aim of this report was to contribute to the development of effective enforcement and countermeasure strategies related to large groups of cyclists on public roads by reviewing the published scientific literature and selected video footage of bunch riders. The request for this research was made to the Monash University Accident Research Centre Baseline Research Program Committee by Victoria Police, following the coronial inquiry into the death of an elderly pedestrian as a result of a collision with a cyclist who was riding in a bunch. The research was conducted in two stages, first a review of the published scientific literature on bunch riders and an expanded literature review, and second, an analysis of footage provided by Victoria Police of bunch riders along Beach Road, Melbourne. It was anticipated that these two research stages would inform effective strategies and countermeasures to address safety issues related to bunch riders.

An initial focussed analysis of cyclist collisions between 1 January 2001 to 31 December 2006, using the peak bunch riding times (weekends from 6.30am to 10.30am) as the inclusion criteria, revealed that only 7 per cent of all cycling collisions in Victoria occurred during these times. This is a small proportion of the total number of cyclists who were involved in collisions during this period and this analysis revealed that available data is not sufficient to determine the magnitude of the safety risk to bunch cyclists as distinct from the broader cycling population, as bunch riders may have been involved in collisions outside these times.

A review of the literature found that only three publications specifically addressed bunch riding, these publications have been reviewed in detail. Due to the paucity of literature, the review was expanded to include issues surrounding professional cyclists, aerodynamic benefits of bunch riding and bicycle couriers. Also included, in response to the recommendations from the coronial report, is a discussion of the current legislation and enforcement strategies, with particular attention given to riding through red lights, riding more than two abreast and riding in large bunches. No formal education programs that specifically targeted riding in a bunch were found in this review, although information is available online, that provides tips on riding in a bunch, and information is included in the cycling Code of Conduct.

The second stage of the research project was to analyse two discrete video recordings of bunch riders provided by Victoria Police. The footage was from two separate time periods, 2005 and 2007. The 2005 footage was taken from street level and followed large bunches (over 100 riders), the 2007 footage was taken from a police helicopter and followed smaller bunches of riders (30-40). A content analysis of the footage identified behaviours that were in breach of three main road rules, namely riding through a red light (RR56), riding more than two abreast (RR151) and riding in more than one lane on the road (RR146).

The behaviour of cyclists in the footage from 2005 was in breach of all three road rules, with cyclists riding more than two abreast for the entire footage, almost the whole ride the cyclists were in more than one lane (90%) and almost half of the red lights faced were ridden through (46%). In comparison, there were dramatic reductions in the breaches of these three rules in the 2007 footage. Cyclists rode more than two abreast for only 5 per cent of the total ride, and in more than one lane of traffic for only 2 per cent of the total ride. Furthermore, no cyclist rode through a red light during this footage. However, at the end of the 2007, footage the behaviour was indicative of an unofficial race, as cyclists accelerated towards a roundabout. It is not known if the 2007 footage is representative of

the current style of bunch riding and if the positive behavioural changes have been made by all bunch riders.

The discussion addresses cyclists' behaviour, how cyclists and drivers use the road space, the inconsistencies of how cyclists are permitted to use the road and the size of bunch. Education, the implementation of leaders in the bunch and the Code of Conduct are also discussed. The current legislation and enforcement strategies and the potential for the use of 'hoon driver' style legislation are also addressed. The Council responsibility, the need for consultation with residents and cycling groups before implementing change to the road environment is addressed separately.

There are limitations to the conclusions and recommendations that can be drawn from the available data. The lack of scientific research in the published literature means that an established approach cannot be applied to the current situation. There are also dissimilarities between the 2005 and the 2007 video footage in content, methodology and situational factors.

Recommendations for future research are made, and include further observations to determine the current bunch riding environment including exposure data, bunch speed and size. Recommendations are also made for more in-depth analysis of the available crash data, a comparative analysis of infringement rates of bunch riders and single cyclists to determine the issues that are particular to bunches, and an evaluation of the parking restrictions that are already in place along Beach Road to determine their effectiveness in improving overall safety. Should the initial observation studies find that there are ongoing issues with bunch rider behaviour, further research is recommended that investigates the effectiveness of other measures including advanced red light warning signs; deterrents and penalising strategies; consultation with key stakeholders; and experimental work to understand the types of limitations/restrictions needed to improve the safety of bunches, and trials of innovative infrastructure measures for cyclists.

1. INTRODUCTION

In August 2006, an older male pedestrian was fatally injured as the result of a collision with a cyclist who was riding in a bunch on Beach Road, Melbourne. The circumstances of and contributing factors to the fatal injuries sustained by the pedestrian were investigated by the Victorian State Coroner who found in his final report that the behaviour of the group of riders involved in the collision was 'indicative of a high risk event or activity that is not suitable for either suburban streets or on main roads where the public frequent'(Victoria State Coroner's Report, 2007: 5). The main focus of concern was the inability of individuals within the group to stop at traffic signals when the group was travelling at speed (Victoria State Coroner's Report, 2007: 7). Also of concern were the safety consequences of riding in a bunch and the breaches of road rules. In his report, the Coroner specifically identified the behaviour of cyclists known as 'Hell Riders' as the primary problem (Victoria State Coroner's Report, 2007: 12).

In his findings, the Victorian State Coroner endorsed the suggestion from Victoria Police that a submission be made to the Monash University Accident Research Centre (MUARC) Baseline Research Program Committee to conduct research to identify effective enforcement and countermeasure strategies that may address the specific safety concerns with respect to groups of cyclists (Victoria State Coroner's Report, 2007: 14). The Coroner suggested a range of issues that should be considered in the research that included: improvements in education, distribution of the Code of Conduct, enforcement methods, penalty structure for breaches of the road uses and group size restrictions.

The proposal that was submitted to the MUARC Baseline Research Program Committee requested a review of the published literature on cyclists who ride in large groups, i.e., those who engage in 'bunch riding', to contribute to the identification and development of effective enforcement and countermeasure strategies. In addition, Victoria Police provided video footage of bunch riders along Beach Road for review and analysis. The video footage, over two hours in total, targeted the 'Hell Riders'. An important point of distinction is that the term 'Hell Riders' refers to a specific subgroup of cyclists, as distinct from other 'bunch riders' and the route itself. The review of the video footage is included in this report.

1.1 CRASH STATISTICS

An initial review of collisions involving pedestrians and cyclists was conducted using the VicRoads crash statistics database, CrashStats, for the five year period from 1 January 2001 to 31 December 2006 and the appendix to the Victoria Coroner's report entitled *'National Incidents of Unintentional Fatalities involving Pedal Cyclists'*(Victoria State Coroner's Report, 2007).

1.1.1. Collisions involving pedestrians

During the five year period, a total of 4,319 pedestrians were involved in injury collisions, resulting in 329 (8%) fatalities and 3,990 (92%) serious injuries. The majority of fatalities (94%) and serious injuries (93%) involved collisions with vehicles. No other pedestrian fatalities occurred along Beach Road during the five year period, other than the one discussed above.

The majority of collisions involved male pedestrians (58%), pedestrians aged 18 years and over (78%) and occurred in speed zones of 60km/h or less (81%). More collisions occurred

at a mid-block section of road (54%) compared with collisions at intersection and in metropolitan Melbourne (81%) compared with non-metropolitan Victoria (19%).

A large proportion of collisions involved pedestrians aged 60 years and over, collisions that resulted in both fatalities (40%) and serious injuries (22%). Older pedestrians are more frail and sustain greater injuries than younger pedestrians, however older pedestrians are also over-represented in non-vehicular collisions that are a result of falling or tripping (Oxley, Corben, Fildes, O'Hare and Rothengatter, 2004).

1.1.2. Collisions involving cyclists

During the five year period, a total of 2,217 cyclists were involved in injury collisions, resulting in 48 (2%) fatalities and 2,169 (98%) serious injuries. The majority of fatalities (91%) and serious injuries (85%) involved collisions with vehicles. The majority of collisions involved male cyclists (79%), cyclists aged 18 years and over (63%) and occurred in speed zones of 70km/h or less. More collisions occurred at an intersection (58%) than at a mid-block section of road (42%) and in metropolitan Melbourne (73%) compared with non-metropolitan Victoria (27%).

It was not possible to determine from the available crash statistics if the cyclists involved in a collision were riding in a bunch at the time of the collision. Weekends from 6.30am to 10.30am has been identified as the preferred bunch riding times (Burridge, Lajbcygier and Lema, 2003), using this criterion, over the five year period there were 101 collisions resulting in 4 fatalities and 97 serious injuries. All four fatalities in this period occurred on days with dry, clear conditions. Of the 97 serious injury cases, 84 per cent involved a collision with a vehicle and 71 per cent occurred in speed zones of up to 60km/h.

Beach Road

As Beach Road is a recognised bunch riding circuit and the focus of the coronial report, the cyclist collision statistics were analysed in further detail. For the purposes of this analysis, Beach Road was defined as the portion of road from Bay Street in Port Melbourne to the intersection with the Nepean Highway at the roundabout in Mordialloc. However, it is noted that the 'Hell Ride' circuit continues beyond Mordialloc to Frankston and further along the Mornington Peninsula. In the five year period, there was one cyclist fatality and 89 serious injuries. The cyclist fatality involved a 50 year old male cyclist who died as a result of a head-on mid-block collision with a station wagon between 9am and 10am on a Sunday in January 2001.

Of the 89 serious injuries that occurred along Beach Road, the two major collision types were a cyclist hitting a parked vehicle (19%) or colliding with a right turning vehicle (12%). The majority of collisions occurred at mid-block (57%) or at a T intersection (36%), which is not surprising, given that there are only T intersections along this portion of road. The three months when most collisions occurred were January (13%), August (12%) and September (12%) and there were more collisions on the weekend (Sunday 26%, Saturday 21%) than during the week.

1.1.3 Collisions involving pedestrians and cyclists

There were no other pedestrian fatalities as a result of a collision with a cyclist in Victoria prior to (or since) the death of the elderly pedestrian in August 2006 in the time period analysed. In the coroner's report, there were details of two other pedestrian fatalities

resulting from a collision with a cyclist. The first collision occurred in New South Wales in 2002, an elderly female pedestrian (78 years) was involved in a collision with a cyclist (no further details available). The second collision occurred in Tasmania and involved a female pedestrian (37 years) who was crossing at a pedestrian crossing with the green 'walk' signal when a male cyclist (16 years) who was travelling towards the intersection (downhill) at approximately 60km/h, he braked, skidded and struck the pedestrian. The pedestrian died as a result of the head injuries sustained (Victoria State Coroner's Report, 2007).

In Victoria during the five year period, collisions between cyclists and pedestrians resulting in serious injuries accounted for 1 per cent of all pedestrian serious injury collisions.

1.1.4 Summary

It is not possible to quantify the magnitude of the safety issue related to bunch riders from the data available. While weekends from 6.30am to 10.30am were identified as preferred bunch riding times, websites that advertise bunch rides range in times from as early as 5.30am and across all days of the week, especially those rides organised by cycling clubs. Given the large number of non-bunch riders, including commuter cyclists and school children, who are also on the road in the early mornings during the week, it is not possible to differentiate the bunch riders in the crash statistics.

It is also important to note that the crash data presented here are not adjusted for exposure. There is a paucity of information on how many cyclists are using the road system and when, where and how frequently they ride. These data are critical for a more complete interpretation of the crash statistics. For example, the high proportion of males involved in collisions *may* be a result of more males (64%) cycling than females (36%) (Department of Communications Information Technology and the Arts, 2006) or different propensity for risk taking behaviour of males and females (Garrard, Crawford and Hakman, 2006). Similarly, the over-representation of adult cyclists in fatal and serious injury crashes may be more likely to be attributable to their greater exposure on the roads rather than children being safer cyclists than adults. Accurate exposure data is essential to advancing our understanding of the relative risk status of different groups of cyclists (e.g. age group or gender) and different cycling patterns (roads cycled on and traffic situations).

2. AIM

The aim of this report is to review the scientific literature and video footage related to cyclists riding in large groups or bunches on public roads to gain a better understanding of the behaviour of bunch riders and the contribution to crash risk in order to identify potential recommendations for effective enforcement and countermeasure strategies.

3. METHOD

This study was undertaken in two parts. First, a review of the relevant literature was undertaken, and second, an analysis of video footage of bunch riders taken by Victoria Police and made available to MUARC for the purposes of this study.

3.1 LITERATURE REVIEW

An extensive search of the literature was conducted and included an online search of academic journals, conference proceedings and searches of relevant library catalogues. Key terms used in the searches included *bunch riding, group riding, cycling road training, pelotons, weekend warrior, cycling enforcement* and combinations of these terms with *motorists, drivers, pedestrians* and *traffic*. From this review, only three publications that directly addressed bunch riding were identified and these are critically reviewed in detail below. Due to the paucity of published research, the review was expanded to include publications addressing the wider issues of cycling performance and behaviour and those that addressed elements of bunch riding. Publications that addressed issues relating to professional cyclists; the aerodynamic benefits of bunch riding, often referred to as a main benefit of bunch riding; and the courier literature, as similar cycling behaviour is associated with both bunch riders and couriers, for example running red lights, were also sought.

3.2 ANALYSIS OF VIDEO FOOTAGE

Victoria Police provided footage of bunch riders on Beach Road and Nepean Highway along the main metropolitan Melbourne bunch riding circuit to MUARC for review. The footage was taken in February 2005 and July 2007 and was generated for Police internal purposes. Victoria Police noted that this footage deliberately targeted 'Hell Rider' cyclists and was not representative of all cyclists along Beach Road.

The footage from 2005 was taken at street level with a camera positioned in a vehicle that followed bunch riders. In 2007, the footage was taken from a Police helicopter. In both observations the riders were filmed travelling out-bound, the return trip was only filmed for one of the 2007 observations. A content analysis of the footage was conducted and the findings are presented using descriptive statistics.

4. LITERATURE REVIEW

Bunch riding is a style of riding where cyclists ride in tight formation, typically in rows of two abreast. Bunch riders cycle on public roads and the general public often have little experience and are unfamiliar about how to interact with large groups of cyclists (Burridge, Lajbcygier and Lema, 2003). On public roads in Australia there is little infrastructure provision for bunch riding outside a race event. Three publications directly addressed the issue of bunch riding. The first is a document outlining the Bayside City Council Bicycle Strategy. The second is a report in response to the strategy by Burridge, Lajbcygier and Lema entitled *Draft Response to: 'Bayside City Council Bicycle Strategy'*. The third is a peer-reviewed journal article by O'Connor and Brown titled '*Real Cyclists Don't Race: Informal Affiliations of the Weekend Warrior'*. All authors are based in Melbourne and focus on Victorian bunch riders. The Bayside City Council bicycle strategy and the Burridge et al report focus exclusively on Beach Road, while O'Connor and Brown also discuss regional locations.

4.1 BUNCH RIDING LITERATURE

4.1.1 Bayside City Council Bicycle Strategy, 2003

The Bayside City Council Bicycle Strategy, 2003 was prepared by David Lock Associates and PBAI Australia. The report reviewed and updated the council's 1997 cycling strategy and was developed with reference to the Victorian Government's lane use and transport planning policy *Melbourne 2030 – Planning for sustainable growth*. The report stated that cycling is an important alternative mode of transport and that the Bayside area is a desirable location for cyclists. The strategic objectives included an increase in the volume of cyclists and the percentage of commuter trips made by bicycle, reduction of accidents by 15 per cent per year and a positive rating of cycling by cyclists and non-cyclists (p.5).

The report also made 23 recommendations under the four broad categories of: improving the cycle network – infrastructure/planning works (8 recommendations); promoting cycling (8 recommendations); educating the community on cycling rights and safety issues (3 recommendations); and, improving cycle provisions in activity centres and at other key destinations (4 recommendations).

The strategy identified the importance of providing clear, connected cycle routes that are continuous and on-road markings delineating between bicycle and vehicle space (p. 22). The report included an Action Plan with an estimated costing of over $1.2 million over a five year period including $755,000 high priority tasks, of which, $226,000 related to increased access to the off-road Bay Trail bike path.

The report relates primarily to occasional riders who cycle at slow-speed and off-road, with a strong emphasis on residential streets and the off-road Bay Trail. For most of the report, cyclists are described as road users with similar vulnerability and travel needs as pedestrians and this clearly does not refer to the on-road bunch riders who travel at higher speeds and entirely on the road. One section of the report (A-5), refers to training cyclists and notes that cyclists as a user group did not support the installation of traffic islands, median strips or pedestrian refuges that would narrow the road width. Yet in the implementation section of the report, costing is included for the installation of seven on-road pedestrian refuges. Assumedly these refuges are raised concrete installations that provide a safe space in the middle of the road for pedestrians to wait as they cross the road. The safety implications of these installations for on-road cyclists were not addressed.

In addition, the substantial financial commitment to the development and maintenance of the off-road Bay Trial may also have safety implications for on-road cyclists. There is evidence in the broader cycling literature that drivers are resentful when cyclists do not use the facilities provided (Basford, Reid, Lester, Thomson and Tolmie, 2002). This resentment may be confounded by the attitudes of some drivers that cyclists are not legitimate road users and may have safety implications for cyclists, for example, as drivers try to overtake with insufficient space.

The authors also suggested that one lane may be closed to vehicular traffic for a designated number of hours to provide space for training cyclists. The options for restricting or prohibiting parking was also listed as part of the VicRoads guidelines to providing additional on-road space for cyclists, but this was not discussed in the report.

4.1.2 Burridge, Lajbcygier and Lema, 2003

The report by Burridge et al, 2003 was written on behalf of the cycling group, Beach Road Cyclists (BRC), in response to the Bayside City Council's proposed bicycle strategy. The authors responded to recommendations that they believed would be detrimental to on-road cyclists. At the time of the report, Burridge and Lajbcygier were senior academics at Victoria University and Monash University respectively and Lema was an ambulance paramedic, former elite cyclist and coach. Although the Burridge et al report is not peer reviewed, it offers unique data on bunch riders that has not been presented elsewhere.

Burridge and colleagues conducted an observational study to identify characteristics of on-road cyclists compared to other cyclists using the adjacent off-road bike trail (Bay Trail) and a survey to investigate the characteristics of on-road cyclists. The observational study was conducted over three days (Saturday, Sunday and Wednesday) in December 2003 and a manual count of cyclists at two locations along Beach Road between 6.30am and 10.30am. In addition to counting the number of cyclists, during observations on the Saturday the researchers also recorded the type of bicycle for all cyclists, the size of the bunch for on-road cyclists and details of the types of users on the off-road path. The survey was distributed to on-road training/commuter cyclists in the cafés along the foreshore at Elwood and St Kilda, cyclists were encouraged to complete the survey immediately and return it to the researcher or return post the completed survey. The survey totalled eight questions that addressed: number of days per week the cyclist rode on Beach Road, how they described their cycling, where they rode, likelihood to ride in a bunch and bunch size, major issues for cyclists, suggestions to improve and increase cycling along Beach Road.

The observational study found that the majority of riders (97%) travelled on the road compared with using the bike trail on all observation days. There was a greater proportion of on-road cyclists on the weekend mornings, (95.8% and 93.6% respectively at two counting sites) compared to the weekday (Wednesday) when on-road cyclists accounted for 86.9 per cent of riders. Given these large differences between the number of on-road and off-road cyclists across different days, the authors argued that that the greater number of Beach Road cyclists were training rather than commuting or recreational.

The survey yielded 78 responses and the authors stated that this was a 'strong' response; however the number of surveys distributed was not included in the report. The authors reported that 100 per cent of respondents answered that 'sporting/training/fitness oriented' best described their cycling practices (the other options included 'casual/recreational' and 'other').

The authors concluded that the Bayside City Council had a duty of care to establish a safe cycling environment. They also made a number of recommendations for the Council to consider included allocating cycling space on the road, prohibiting parking and heavy vehicle activity and a reduction of vehicular travel speeds. The impact of these recommendations on other road users and the residents of the area were not addressed. Further research is required to determine the merit of the recommendations for on-road cyclists as well as other road users in general.

A number of important limitations of this study should be noted. The study was conducted by on-road cyclists, it focuses solely on on-road cyclists and does not provide any information on how many vehicles or pedestrians were also using the space. The report focused on the importance of bunch riding from the perspective of the cyclist, and the recommendations reflect only the interests of this group. In addition, there are inherent

biases in the data as they were only collected from on-road cyclists and not any other road user group including cyclists using the bike path, drivers or pedestrians. The recommendations did not suggest that any modifications could be made to individual or collective bunch riding behaviour nor did they address the responsibilities of bunch riders with regard to their interaction with other road users.

The Burridge et al report stated that more than 4,500 riders cycled along Beach Road each weekend in 2003. It is assumed, given that has been a significant increase in cycling in recent years (Department of Communications Information Technology and the Arts, 2006; City of Melbourne, 2007) that the number of Beach Road cyclists has increased however, more recent figures have not been published.

4.1.3 O'Connor and Brown, 2007

The journal article by O'Connor and Brown is peer reviewed and while the article begins with regional cyclists, the main focus of the research is bunch riders on Beach Road. The study is qualitative, based on ethnography (participant observation) and semi-structured focus group interviews. O'Connor is a road cyclist who belongs to a cycling club and he observes that, despite the growing number of cyclists riding and training on the road, the number of cycling club members are decreasing; in 2007, there were only 2,600 club cyclists in Victoria. The authors explored the structure of bunch riding and focus on the cyclists' perspective.

The data collection combined participant observations and focus group sessions with bunch riding groups and formal cycling club groups. The participant observations are listed as four years of participant observation in various locations and cycling formats. From the text it is apparent that the bunch riding experience includes Beach Road and regional locations, however specific dates were not included.

O'Connor and Brown's overall observations were that early morning bunch riders were predominantly male, 'most from middle to high socio-economic status, and the majority between 30 and 50 years old' (p.83). Eight focus groups were conducted with 47 cyclists (42 males and 5 females) aged between 25 and 55 years. The authors acknowledged the gendered nature of cycling and that this sample is representative of the male dominant participation rates in cycling with an 'even mixture' of club cyclists and recreational/non-club cyclists. The cyclists' experience levels were not stated. The authors found that bunch riding offers a positive cycling experience for many riders. The benefits included: the opportunity to cycle at a steady pace with like-minded people; safety of a larger group; and to build social networks through conversations while riding and at the end of ride café stop. For these cyclists, their riding etiquette is both inside the group, pointing out objects on the road, taking turns leading the group and outside the group with cyclists riding two abreast.

The researchers also identified that there are some cyclists who engage in bunch riding for the thrill of physically demanding racing. O'Connor and Brown noted that 'for these bunch riders there are pre-determined, imaginary finish lines and, during some sprints, riders will appropriate the entire lane with disregard of other road users in order to "win"' (p. 82). These groups tend to be 'faster [and] fitter, and the larger the bunch, the more aggressive, assertive (of both cyclist and road user) it became' (p. 90). They also noted that 'riders in these faster groups seem to be attracted to the collective ability of a bunch to 'sustain speed, power [and] exhilaration' (p. 92). Importantly, O'Connor and Brown found that these bunch riders are likely to run red lights if stopping means that the group will be split

and riders will be separated from the faster front cyclists. From these findings, they concluded that, while from an external point of view bunch riders appear to be a homogenous group that is predominantly male with lycra outfits and expensive bikes, bunch riding serves a different function for different riders. Cyclists have a clear distinction between bunch riders who ride and bunch riders who race.

While bunches may be informally organised, they respond as a collective. When they believe that a vehicle has passed intentionally too close or a car door is opened in the path of cyclists the reaction from the group may include yelling profanity and obscene gestures (Albert, 1999). It is possible that cyclists feel safe to confront a driver while in a group, however there has not been any investigation to determine the proportion of bunch riders who behave aggressively or if there is a greater incidence of cyclist instigated confrontation when a cyclist is part of a group compared to when they are cycling alone.

4.1.4 Summary of the literature on bunch riding

These are the only publications identified in this literature review that directly address 'bunch riding'. There are no updated figures since the 2003 count in Burridge et al's report and no published figures exist for bunches outside of Beach Road in metropolitan Melbourne. The proportion of cyclists who are riding unsafely on public roads is unclear. From these publications it appears that cyclists mainly bunch ride in the early morning on the weekends, presumably as this is when there are the least number of vehicles on the road.

It is apparent that the main purpose for weekend on-road cycling is training or fitness, this purpose lends itself to bunch riding and sharing the experience with like-minded riders. While externally bunch riding appears unstructured and nebulous, according to online information (Beach Road Cyclist, 2008) there are specific start times and locations and these unofficial events are regular, organised and occur beyond Beach Road. Although bunch riders are attracted to the lack of 'officialdom' associated with organised cycling clubs (O'Connor and Brown, 2007), a central organisation or register of regular bunch rides may improve safety and convenience for all road users.

In relation to the size of bunches, it cannot be determined from the literature if there is a correlation between the size of a bunch and its inherent safety. Intuitively, a large bunch of cyclists riding legally and considerately would be safer than a small bunch of cyclists who are riding recklessly and illegally. However, this does not preclude the possibility that the size of a bunch may have physical implications to suggest that size should be limited, for example, the size of a bunch may impact its safe stopping distance, speed and space the bunch occupies on the road. Further research is needed to determine these characteristics and evaluate if there is a need to limit the size of bunches to improve the safety of both cyclists and other road users.

Burridge et al. (2003) argued that groups are 'organic' and that there was no way of controlling how large a group grew, as groups increased and decreased in size throughout the ride. This was made in response to the suggestion of 'bunch licences' made in the Bayside City Council strategy. There is no evidence to support the implementation of bunch licences, however by determining if there is a need to limit the size of a group for road user safety, then key stakeholders need to develop a cost efficient and effective strategy to manage bunch size.

The Victorian State Coroner stated that a lack of leadership within the bunch on the 'Hell Ride' to ensure safe riding practices contributed to the pedestrian's death (Victoria State Coroner's Report, 2007). The absence or presence of a leaders in bunches is not known. O'Connor and Brown observed that there is most often a leader in bunch rides, either nominated by the group or assumed by the fittest rider, however others assert that attempts to introduce leaders to groups have been met with derision from riders and their efforts to modify group behaviour have been ignored (personal communication with Lema and Lajbcygier). More research is needed to understand the presence of leaders and the extent of their ability to affect change in a bunch.

4.2 EXPANDED LITERATURE REVIEW

Due to the paucity of research related to bunch riding, this literature review was expanded to include research that addressed cyclist groups that may have similar behaviours or issues, namely: professional cyclists, the aerodynamic benefits and bicycle couriers.

4.2.1 Professional cyclists

Professional cyclists are extreme sports[men], participating in the 'hardest of sports'(Mignon, 2003:244). Each cyclist has a role within the team including the leader and the *domestiques* who sacrifice the opportunity to win for the betterment of the team (Williams, 1989) and there are laws of silence within the *peloton* to protect the group from accusations from the outside (Mignon, 2003). The popularity of professional cycling is increasing, both the number of people participating (Department of Communications Information Technology and the Arts, 2006; City of Melbourne, 2007) and the media coverage of cycling races. The Tour de France is the third most heavily broadcast sporting event in the world after the football (soccer) World Cup and the Olympics (Dauncey, 2003). As a result an increasing number of amateur and recreational cyclists are now riding on the roads in large groups or 'bunches', emulating a professional cycling *pelotons* (O'Connor and Brown, 2007).

In official road cycling races, the performance and safety of the cyclists are the highest priorities and the interaction between riders and other road users is strictly governed by rules and guidelines that explicitly state the circumstances when a motor vehicle, or motorcycle, may pass a group of riders (International Cyclists Union (UCI), 2003; Australian Cycling Federation, 2007). Within this protected environment, riding in a *peloton* offers teams strategic advantages: stronger teams can dictate the pace of the group and riders can use the aerodynamic benefit to conserve energy (Williams, 1989; Dauncey, 2003).

4.2.2 Aerodynamic benefits

The aerodynamic benefits of riding in a bunch are so significant that drafting is banned in some cycling races (Olds, 1998) and in many formats of triathlons (International Triathlon Union, 2003). When riding over 25km/h the major factor restricting movement is air resistance (McCole, Claney, Conte, Anderson and Hagberg, 1990), to overcome the air resistance, up to 80 per cent of a cyclist's total power output is used and a 'small increase in speed requires an exponential increase in power output'(Jeukendrup, Craig and Hawley, 2000: 417). By riding in formation, the front riders shield the following riders from the wind thus allowing them to 'draft' or 'slipstream' and ride at the same speed, using less energy (Kyle, 1979; Williams, 1989). Using oxygen uptake as a measurement of improved performance, riding behind one rider reduces oxygen uptake by 18 per cent (McCole,

Claney, Conte, Anderson and Hagberg, 1990; Olds, 1998) and by up to 39 per cent for a group of 8 riders (McCole, Claney, Conte, Anderson and Hagberg, 1990). There is some variance in the aerodynamic benefit depending on the bunch size, speed and the gaps between the cyclists (Olds, 1998).

In addition to the aerodynamic gain, training cyclists enjoy more social riding in groups with a 'gentleman's agreement' that each rider will take their turn in the lead (Williams, 1989). Bunch riding allows slower cyclists to ride faster and further than they would be able to alone thus permitting riders of varying fitness levels to ride together (Williams, 1989). In addition, the reduction in physical effort allows riders to talk as they are less breathless, even at higher speeds (O'Connor and Brown, 2007).

4.2.3 Bicycle couriers

Bicycle couriers provide a unique service to central business districts both in Australia and internationally. In 2002, one study estimated the value of Boston's bicycle courier services at approximately five-million US dollars annually (Dennerlein and Meeker, 2002). Bicycle couriers are typically young males in their twenties and are often heavily involved in unsanctioned road racing (Nyssa, 2004; Kidder, 2005). Studies found that the motivation for couriers to race through the streets, run red lights and weave through traffic is a desire for speed and the thrill of risk taking. Studies have also found that couriers race before, during and after work and that racing provides a greater motivator to undertake courier work than the financial payment associated with deliveries (Kidder, 2005; Fincham, 2006).

Couriers create an image that separates them from other cycling groups through their language and clothes, which is typically a blend of cycling apparel and street wear clothing (Kidder, 2005). These identifiers are designed to distinguish couriers from other road users, to both include and exclude (Nyssa, 2004). Bunch riders share a similarity with couriers, with unofficial rules of membership expressed by their clothing, the value of their bicycle and their fitness level. Some bunches are protective of their group, 'reluctant to let "outsiders" join in'(O'Connor and Brown, 2007: 90).

The literature on couriers is also important as it highlights the lack of space on the road for cyclists. Their position as neither vehicle nor pedestrian and there is a lack of acknowledgement from other road users that cyclists are legitimate road users (Kidder, 2005: 352).

In terms of couriers' behaviour on the road, it is generally agreed that they engage in risky riding behaviour such as high speed riding, running red lights, weaving in between traffic, etc. Interestingly, there is anecdotal evidence that the behaviour of bicycle couriers has changed in recent years in Melbourne, as a result of a reform of the payment structure. Couriers in Melbourne now receive an hourly rate instead of per parcel delivered in an effort to remove the financial imperative of delivering goods quickly. Victoria Police have observed that this has led to a dramatic reduction in the competitiveness and assumedly the high risk behaviour of cyclist couriers (personal communication). Unfortunately, there is no scientific evidence of these changes and observations in the published literature.

4.3 LEGISLATION AND ENFORCEMENT

A preliminary search of the Victorian and Australian legislation found that there was no legislation specifically pertaining to bunch riding. Inquiries to the Monash University Law Research Centre confirmed that there was a lack of any legislation that addressed bunch

riding. The Law Research Centre suggested that more exhaustive research could be conducted in conjunction with MUARC to conclusively determine if there was any reference in the Australian or international legislation to bunch riding.

In Queensland, there was acknowledgement of the bunch riding style, with the City of Brisbane council website (City of Brisbane, 2007) providing tips and hints on how to ride safely in a bunch, for example, be predictable, don't overlap wheels and obey road rules.

While there is no specific national bunch riding legislation, there are a number of road rules addressing cyclist safety and mobility that do address components of bunch riding, mainly emphasising the behaviour of the individual cyclist:

- Riders must obey traffic signals and red lights (RR56)
- Riders (as other drivers) must travel at a safe distance behind the vehicle in front that would enable them to stop to avoid a collision (RR126)
- Drivers (including riders) must stay within a single marked lane or line of traffic (RR146)
- It is illegal for riders to ride more than two abreast unless overtaking (RR151)
- Where there is a bicycle lane on the road, riders must ride in the bicycle lane (RR247)
- Riders must not cause a traffic hazard by moving into the path of a driver or pedestrian (RR253)

The most important existing road rules that relate to the death of the older pedestrian on Beach Road are RR56 and RR126, that cyclists must obey traffic signals and travel at a safe distance behind a vehicle that would enable them to stop to avoid a collision.

Given the evidence, albeit limited, of specific behaviours and characteristics of bunch riders, there appear to be three main road rules that bunch riders do not adhere to. These include: RR56 – bunch riders run red lights; RR151 – bunch riders cycle more than two abreast; and, RR253 – large bunches are physically too long on the road and move into the path of drivers causing frustration to other road users. Each of these issues, and implications for legislation and enforcement, are discussed in more detail below.

4.3.1 Red lights (RR56)

All vehicles in Australia must stop at all red traffic lights; there is no exclusion for bicycles. As identified in the literature (O'Connor and Brown, 2007) there is a reluctance from some bunch riders to split a bunch by stopping at a red light. The assumption is that riders are trying to improve on their 'personal best' (O'Connor and Brown, 2007) and they will lose too much time if they stopped at a red light and were unable to catch the faster, front group. Bunch riders who run red lights can be prosecuted by Police however, it may be difficult to distinguish individual riders from a large group and costly to enforce.

In addition to the individual pursuit of fast speeds, the Coroner's report identified the pressure from within the group to keep a bunch moving, to keep 'rolling' even if that means riding through a red light (Victoria State Coroner's Report, 2007: 1). According to the report, this was the situation that led the pedestrian's death and the Coroner raised concern that this behaviour had the potential to lead to deaths of cyclists should a bunch 'roll' through a red light and be hit by a vehicle from the cross road (Victoria State Coroner's Report, 2007: 5). The footage of riders sheds some light on the occurrence of

this behaviour and is described in detail in Section 5 of this report, however, the suggestion that riders in tight formation cannot safely stop in time for red traffic lights requires further investigation.

The legislation to obey traffic signals and red lights is universal, with one exception for cyclists. In Idaho, in the United States of America, cyclists are permitted to treat stop signs and red lights as yields, where they must slow down, stop only if necessary for safety, before proceeding through the intersection (State of Idaho, 2007). Cyclists could still be fined for unsafe intersection behaviour (Petty, 2001). No literature was found examining the impact of this legislation, on cyclist behaviour, nor on cyclist safety.

While there are practical issues in enforcing the legislation regarding cycling through an intersection with a red light, no literature was found addressing this issue. Encouragingly, the Victoria Police 2007 footage suggests that this is a behaviour that cyclists themselves have reduced of their own accord. Further observations would be necessary to determine if self-regulation is typical of all bunch riders.

4.3.2 Two abreast (RR151)

The existing legislation addresses the issue of the number of cyclists riding abreast. Cyclists are allowed to ride alongside one other rider and more than one other rider only when overtaking (RR151). O'Connor and Brown (2007) stated that cyclists ride two abreast to emulate professional pelotons, to gain an aerodynamic advantage and when racing to an imaginary finish line. As for cyclist behaviour at red lights, no literature was found addressing the extent of this behaviour, nor the issues surrounding legislation or enforcement. As evidenced in the Victoria Police footage, riding more than two abreast behaviour has changed from 2005 to 2007, however the final minutes of footage from 28 July 2007 showed that the final sprint is still part of bunch riding for some cyclists.

4.3.3 Large bunches (RR253)

While there is anecdotal evidence that 30 is the maximum safe group size, research has not addressed the relationship between group size, speed, stopping distances and safety. The ability to stop safely is addressed in the Victoria road rules (RR126); however, the implications of bunch size, safe stopping distance and speeds have not been examined in the literature. Burridge et al (2003) argued that any restrictions in size should result in the acknowledgement that a bunch ride is a single vehicle and it should then be afforded the same rights on the road as a truck. The obvious counterargument relates to bunch riders then accepting the responsibilities of the truck, including registration and licencing. At this time there is insufficient evidence to support either position.

The issues surrounding bunch size are complex, however, there is a paucity of published literature addressing these issues. Moreover, there are noted problems in terms of enforcement, including how individual cyclists can be identified and how to practically regulate the size of bunches. There needs to be a balance between cyclists having the same rights as other road users and being held accountable when they do breach road rules. Also, while a bunch of cyclists may be able to safely and legally ride for long distances, the impacts of the bunch on other road users has not been explored.

Under the Road Safety (Road Rules) Regulations 1999, there is provision for a race, or similar event, of 30 riders or more. Permission must be obtained from the Chief Commissioner of Police that exempts riders from the rules above (RR403). It is clear from

the 2005 Victoria Police footage that many riders were racing and that, as an unsanctioned race, the riders were in breach of the legislation. However, given the evidence presented by O'Connor and Brown (2007) of cyclists' reluctance to join a club or organised events, it is unlikely that bunch riders would register their ride as a formal race.

4.4 EDUCATION

No formal training programs to develop bunch riding skills were found during this review. Notwithstanding, bunch riding circuits are present in every state and territory in Australia. These are organised formally by clubs and informally by individuals or small groups who join up with larger groups on the road (O'Connor and Brown, 2007). Often the rides spread by word of mouth with a permanent starting time and place (Albert, 1999). Bunch riders are likely to be a mixture of professional riders, cycling club riders and recreational non-club riders (O'Connor and Brown, 2007).

More recently websites are being created to share information about planned group rides. Many of these websites detail the protocols and etiquette of bunch riding and all cycling bunch riding information sites state that riders must obey the law (Ryan, Walters and Sbeghen, 2001; Hodge, 2006; City of Brisbane, 2007). However, as promoted by cycling clubs, the only way to develop bunch riding skills is to practice (White, 2007; Eastern Suburbs Cycling Club, 2007) and there are no minimum requirements for cyclists to achieve before riding on the road in a bunch.

Bunch riders are a specific group of cyclists with a vested interest in riding at speed, with like-minded cyclists. There is little research conducted on the behaviour and crash risk of bunch riders, but what we do know is that some bunch riders engage in risky behaviours that may put themselves and other vulnerable road users at risk. While legislation is in place, promotion and enforcement of safe cycling practices is extremely difficult.

5. BUNCH RIDING FOOTAGE

Victoria Police provided video recordings of bunch riders on Beach Road and Nepean Highway along the main metropolitan Melbourne bunch riding circuit. The footage was taken at two times periods, in 2005 and in 2007. The footage from 2005 was taken on three separate occasions in February 2005, specific dates and times were not provided however given the large number of cyclists and the lack of other road users it was presumably taken on a weekend morning. The 2007 footage was taken on Saturday, 14 July and Saturday, 28 July. Victoria Police noted that footage deliberately targeted 'Hell Rider' cyclists, was not representative of all cyclists travelling along Beach Road and was recorded to understand the behaviour of this group of cyclists alone.

5.1 DESCRIPTIVE STATISTICS

Overall broad descriptive statistics for the footage from 2005 and 2007 are shown in Table 1 below. Variables include length of film, percentage of time cyclists were rode more than two abreast, the percentage of red traffic signals faced that cyclists rode through and the percentage of total time the cyclists rode in more than one lane.

Table 1 2005 and 2007 footage data

	2005	2007
Length of time filmed	1hr 27m	49 mins
Percentage of red traffic signals faced that cyclists rode through	46%	0%
Percentage of total time cyclists rode more than 2 abreast	100%	5%
Percentage of total time cyclists rode in more than a single marked lane or line of traffic	90%	2%

Overall, there was a significant difference between the behaviour of the cyclists in the 2005 footage compared to the 2007 footage. The 2007 cyclists were less likely than the 2005 cyclists to ride more than 2 abreast, ride in one lane and did not ride through any traffic signals.

Due to the camera angle, especially in the 2007 footage, it is not possible to determine gender of all cyclists. However the majority that could be identified were male, all cyclists appeared to be wearing cycling apparel, many in professional cycling team colours and designs. The bicycles were predominately road bikes, although specific bicycle brands or value could not be observed. It was also not possible to report on the age of the cyclists.

More in-depth analyses of the footage were conducted using content analysis with the following existing road rules as the key criteria to review the cyclists' behaviour:

- Riders must obey traffic signals and red lights (RR56)
- Drivers (including riders) must stay within a single marked lane or line of traffic (RR146)
- It is illegal for riders to ride more than two abreast unless overtaking (RR151)

5.2 FEBRUARY 2005

The 2005 footage is 1 hour and 27 minutes and is in four parts, taken on weekends. Riders are followed out-bound from Blackrock in Melbourne's inner suburbs to the outskirts of Frankston following Beach Road and Nepean Highway, a distance of approximately 30km. In each of the four rides, the bunches consisted of approximately 100 cyclists, with the largest containing approximately 140 riders. The footage was taken from a vehicle following the riders, the camera was mounted on the dashboard and filmed through the front windscreen. A small segment of footage was also taken from a parked car that filmed the cyclists as they rode past on the opposite side of the road. The footage is not time stamped but it appears that the rides took place in the early morning between 6.30am and 8.30am.

In the total time that the cyclists were filmed, there were 98 vehicles on the road travelling in the same direction as the cyclists. A count of vehicles on the road on different days and at various times is needed to confirm if this is fewer vehicles than is typical for this section of road. Indeed, it is highly likely that drivers may choose an alternative route at these times, knowing that bunch riders are likely to be using Beach Road. Alternatively, a low number of vehicles on the road may contribute to cyclists choosing to bunch ride at these times. Building on the assumption that there are fewer vehicles on the road in the early

morning, this may also contribute to the manner in which bunch cyclists ride – as if there is no one else on the road.

The video footage revealed that riders seemed oblivious to other vehicles on the road. During the time that bunch riders were filmed, eight drivers waited behind the bunch for a chance to pass before eventually overtaking by crossing over the middle solid white line. The average time that drivers waited was 2:06 minutes, the shortest time was 10 seconds, and the longest time waited was 4:20 minutes. Most of these waiting times were on a dual carriageway, i.e., two lanes in each direction, only a small section of the road was single carriageway.

Throughout the footage the cyclists typically rode 4 abreast and were 16 abreast at their widest point, and the majority of the time they rode in both lanes of forward traffic. Cyclists also spread out across all forward lanes at many of the intersections when they did wait at a red light. Overall, the riders did not use the on-road painted bike lane, regardless of the presence or absence of parked cars.

The majority of cyclists repeatedly rode through red traffic lights, the length of the bunch meant that vehicles waiting to cross with a green light could not safely enter the intersection without colliding with cyclists. At each intersection a small number of riders did stop, however, many cyclists from behind rode around them to continue through the red signalled intersection. This behaviour was not restricted to the timing of phasing changes, i.e., running on the amber light. This behaviour commonly occurred at a significant time after the red light phase had commenced. The lights were clearly red on the cyclists' approach, however, the bunch, in general, did not slow down, instead they continued through the intersection. This behaviour is aggressive and reckless and assumes that all other traffic will give way to the bunch. Indeed, one cyclist gave a wave of acknowledgement to a waiting driver as he illegally rode through the intersection against the red light.

On Nepean Highway, most of the route is dual lane and for short periods of time cyclists rode in tight formation and were within one lane, allowing traffic to pass in the second lane. However, this only continued until a rider crossed into the second lane and other riders followed. On the ride's steepest climb (Oliver's Hill on the outskirts of Frankston) the cyclists ignored the cyclist facilities, i.e., a segregated bike lane, and cycled on the main road, spread across both lanes, with little regard of other vehicular traffic.

5.3 JULY 2007

Saturday, 14 July 2007

This footage, of a single ride is 18:40 minutes and was taken from a helicopter that followed the riders out-bound from Mordialloc to Mt Eliza at 7.30am on a Saturday morning. The 2007 footage is time stamped. The ride was in winter with approximately 40 riders in the group and the road surface reflection suggested the roads were wet. Compared to the 2005 rides, this ride was uneventful. During the majority of the ride, the cyclists were two abreast, occasionally three when passing and spread to four abreast on ascent of the steepest hill on the route. At all times the cyclists were within one lane of traffic and no overtaking cars were delayed.

Similar to the 2005 footage, the cyclists did not use the on-road bike lane for the majority of the ride; particularly where there were some parked cars in the shared bike lane/parking

space, however, the cyclists keep within one lane, the far left lane. At the steep climb the bunch did use the road with the segregated bike path. After the climb, the cyclists rode in tight formation in the on-road bike lane and were completely off the dual carriageway, occasionally a cyclist drifted into the roadway proper.

With regard to red light running behaviour, the video footage did not allow a meaningful analysis of this. The signals were sometimes obscured due to the angle of the camera from the helicopter. However, using the other vehicles on the road as a guide, it appeared that the observed cyclists did not run any red lights.

Saturday, 28 July 2007

The footage for this ride was 24:28 minutes beginning at 7.13am and for the first five minutes follows the riders out-bound from the roundabout at Mordialloc towards Frankston. There were approximately 30 riders in this group. At the roundabout most riders stayed in the left lane, but some rode through the roundabout in the right lane (as if in a vehicle). The bunch reformed into a two abreast group soon after the roundabout and generally continued in this formation for the remainder of the ride. There was one instance of 'racing' within the group as three riders sprinted off from the main bunch, but all the cyclists stayed in the left lane in single file or two abreast. This portion of footage is uneventful, no cyclists rode through an intersection with a red light.

The return trip – City bound

There was a break in the footage and it restarted at 8.25am and the remaining footage followed the bunch on their city-bound trip. It appears to be the same group of approximately 30 riders as at the beginning of the footage. This is the only footage that followed the ride on the return trip. For the majority of the ride the cyclists rode single file or two abreast and within the left lane. There was some jostling for position and at times the riders were three abreast, however, vehicles travelling in the same direction were able to overtake without delay. A Police car overtook the group several times and it is not known if the Police presence impacted the cyclists' behaviour.

At one point the road narrowed from two lanes to one, the cyclists did not yield to the traffic and continued in either single file or two abreast appropriating the entire lane. Along Beach Road, the cyclists mostly travelled in a single lane, in single file or two abreast, and stayed within the left lane unless overtaking a parked car or slower moving cyclists. The bunch increased in size along Beach Road, to approximately 37 cyclists, as the group overtook slower cyclists who then joined the back of the bunch. As the road narrowed the cyclists used the on-road bike lane (distinct from the off-road bike path 'Bay Trail', that is adjacent to Beach Road). The cyclists did not pose a hindrance to vehicles that freely overtook the group in the right lane.

This ride was similar to the footage from 14 July 2007; cyclists were notably more orderly than the 2005 riders. Cyclists rode within a single road lane and obeyed all traffic signals however, this changed during the last few minutes of footage on the approach to the clock tower in Blackrock. At this point the front cyclists clearly made head checks to see the positions of other riders, then accelerated and a breakaway pack of 12 riders sprinted ahead from the main bunch. These 12 riders were clearly racing and as they raced, they overtook a separate bunch of 9 riders, spreading out across both lanes of the road, the 12 sprinted to an imaginary finish line. The remaining cyclists from the original bunch stayed in the left lane and continued in single file or two abreast to the end of the footage.

Despite this racing finish, there was a distinct difference in the way the cyclists rode in the 2007 footage compared to the 2005 footage. The 2007 riders appeared aware of other road users and, excluding the racing finish, the cyclists did not encroach on the right lane in the dual carriageway. The main observations of dangerous behaviour from the 2005 footage such as running red lights, riding more than two abreast and taking up two lanes of traffic, were absent from the majority of the 2007 footage.

However, the footage provided is not sufficient to determine whether there has been an improvement in all bunches who ride this circuit. In 2005, the footage was taken in summer with more than 100 riders in each group and the 2007 footage was taken in winter with select groups of 30-40 riders. It is still not known if poor bunch riding behaviour is a result of large groups, or other contributing factors and therefore it is unclear as to whether limiting the size of bunches can result in improved cycling behaviour and therefore safety. It is also not known if the observed differences of riders in 2007 compared with the 2005 riders are indicative of all riders, or are an artefact of environmental or other differences. It was also not clear from the footage what time of the morning the 2005 riders were on the road and if this was comparable to the 2007 riders.

6. DISCUSSION

The purpose of this study was to report the findings from the published literature on bunch riding and review the Police footage to contribute to the development of effective enforcement and countermeasure strategies to improve their overall safety. It was envisaged that best practice used in other jurisdictions or internationally would inform Victoria Police in managing issues related to bunch riders in Victoria, particularly on Beach Road. A literature review and a content analysis of the video footage were conducted. Only three publications that directly addressed bunch riding were found and the video footage revealed substantial differences in the cyclists' behaviour between 2005 and 2007. The discussion below addresses cycling behaviour, including the way in which cyclists use the road and bunch sizes. It also discusses the roles of education (including educating leaders and the Code of Conduct); legislation and enforcement, and council responsibility in improving the behaviour and ultimately crash risks associated with these groups. Lastly, limitations of the research are noted.

6.1 CYCLIST BEHAVIOUR

A key finding of this study was the dramatic difference in behaviour of cyclists who were filmed in 2007 compared with the cyclists filmed in 2005. The two main types of poor cyclist behaviour that were observed in the 2005 footage, namely riding through red traffic signals and riding more than two abreast was minimal in the 2007 footage. In this discussion two elements of cycling behaviour that is particular to bunch riding are addressed further, the way bunch cyclists used the road space and the size of bunches.

6.1.1 Use of the road space

Under the current legislation bicycles are classified as vehicles and as such are entitled to use the road space as a motorised vehicle does. However, the provision of bicycle lanes creates the expectation that cyclists will keep to the left of the road. While the bunch riders did not always use the designated bike lane, in 2007 they did cycle in the left, kerbside lane of the road. Travelling in this position, drivers interact with cyclists as a separate group that uses a restricted area on the road.

There is one major roundabout on the route, the roundabout has two lanes and there are no line markings for bicycles through the roundabout. When riding through the roundabout, some cyclists travelled in the left, or outer lane, which continues the 'cyclist' position, while others rode through the roundabout in the right, or inner lane, as they might if they were in a vehicle.

The expectation, created by bicycle lanes and the behaviour of bunch cyclists along this route prior to the roundabout, is that the riders will keep left. The use of the right lane appeared to cause confusion for drivers in the 2007 footage. This highlights the inconsistencies of space available to on-road cyclists, how cyclists interact with vehicles and driver expectations of how cyclists use the road space.

In addition, the style of bunch rides has more in common with a race without the officialdom, than a single rider or a small group of recreational or commuter cyclists. Given this style, the Project Advisory Committee (PAC) raised the question of whether it is appropriate to use public infrastructure, designed primarily for transportation, as a venue for semi-professional and professional athletes. The PAC suggested that clear definition needs to be added to the legislation related to a race or 'similar event' of 30 or more riders (RR403) to determine whether cyclists in bunch rides need to comply with special event race rules.

6.1.2 Limiting bunch sizes

There has been suggestion that limiting the size of bunch rides may reduce the associated risks. Proposing such limits assumes that there is a direct relationship between the number of riders and their behaviour, that the larger the group the more likely they are to ride unsafely and/or illegally. Indeed, in the bunch rider footage that was reviewed, there was a distinct difference in the behaviour of the cyclists in the smaller 2007 group (30-40 riders) when compared with the larger 2005 group (100-140 riders). However, it is not clear how much the reduction in the size of the group contributed to the improvement in behaviour or how much behaviour change was influenced by other factors.

This does not mean that bunch sizes should not be limited, however, before an arbitrary limit on size is considered, elements of bunch riding behaviour should be evaluated, for example: establishing the length of time and distance needed for a group travelling at various speeds to stop safely; the impact of the length of a bunch on other road users; and the impact of size on the behaviour of the group.

With regard to how limiting bunch sizes can be achieved, bunch riders themselves argue that they cannot control the size of the group (O'Connor and Brown, 2007; Burridge, Lajbcygier and Lema, 2003), that the size of the group will increase and decrease during the ride. From an enforcement perspective there are also implementation issues, as it is difficult to identify who should be sanctioned when a bunch is oversized.

There is perhaps potential for cycling groups and clubs to play some role here, as well as educational programs. There are groups in Victoria, for example in Bendigo, that organise ride groups by speed and self-regulate their size to no more than 30 riders. An evaluation of the strategies employed by existing groups may provide valuable insight into effective strategies.

6.2 EDUCATION

No formal education programs were found in the conduct of this review. There were, however, some informal strategies that have been introduced including the establishment of bunch leaders as well as an update to the cycling Code of Conduct.

An updated cycling Code of Conduct was launched in December 2007. The Code of Conduct was developed by Victoria Police in collaboration with cyclist groups, VicRoads and the Transport Accident Commission (TAC). The publication provides information on regulations and traffic infringements and well as tips on safe and courteous riding behaviours. The Code specifically addresses riding in groups and suggested no more than 20 riders in a bunch. An evaluation of the distribution of the Code of Conduct and its impact on cyclist attitudes and behaviour is needed to determine its effectiveness.

It has been suggested that the introduction of a leader to the group will have a positive effect on ensuring safe riding practices. However, the beneficial effects of a leader are yet to be determined. The evidence is inconclusive and seems dependent on the type of group. In some groups, the fittest and fastest males in the group may act as leaders and give direction to other riders, points out objects on the road and will call for people to take their turn at the front of the group (O'Connor and Brown, 2007). The leader in this role was perceived as having a positive effect, as the leader kept the bunch together as a group (O'Connor and Brown, 2007: 89). Referring specifically to 'Hell Riders', introducing a leader to the ride has had mixed responses, as was noted by both Victoria Police and Cycle Sport Victoria (CSV), the peak body for racing cycling, in their submissions to the coronial inquiry. Victoria Police stated that 'the absence of leadership or organisation of the ride results in a lack of direction and self scrutiny'(Victoria State Coroner's Report, 2007: 9). In contrast, CSV stated that 'Efforts to use elite cyclists as role models have not succeeded in establishing a culture whereby those participating in the "Hell Ride" listen to and follow requests by those role models to modify behaviour'(Victoria State Coroner's Report, 2007: 10).

As the bunch riders are typically male, gendered research into the psychology of how males behave in groups, how the hierarchical structure of males impacts the group and the role of the 'alpha' male (Schell, 2007) may offer some valuable insights into how positive change can be affected in bunch riders.

Consideration could also be given to developing publicity and education campaigns that target both cyclists and drivers and may include campaigns on safe cycling, bunch riding and the related offence and penalties. Such programs may play some role in enhancing the impact of enforcement and provide some deterrence amongst bunch riders as well as providing information for the public generally on safe ways to interact with cycling bunches.

6.3 LEGISLATION AND ENFORCEMENT

One of the most dangerous behaviours of bunch riders is riding through red lights. This behaviour was not evident in the 2007 footage and it may be that cyclists have self-regulated and this behaviour is no longer an issue. In that case, bunch rides should be periodically monitored to ensure this is a permanent change. However, the absence of red light running in the 2007 footage may also be an artefact of the time of year, weather conditions, presence of Police, or a number of other factors. Should the footage reviewed not be representative and cyclists are still riding through red signalled intersections, then

efforts need to be considered to reduce this behaviour. A series of targeted Police blitzes at key intersections could be considered to reinforce the laws of red light running.

Existing legislation is unlikely to be effective if offending cyclists are not prosecuted. It is possible that the presence of Police in the 2007 footage, both in the helicopter and on the road in marked vehicles, may have had some positive impact on the riders' behaviour. There may be a role for regular Police presence to influence positive behaviour change. Indeed, there is strong and consistent evidence that an increase in Police presence has been successful in targeting other unacceptable road behaviours, such as speeding behaviour (Harrison, Fitzharris, Newstead, Gelb, Diamantopoulou, 1999; Zaal, 1994).

Given the high socio-economic status of many cyclists who ride in bunches; a monetary fine may be not be a sufficient deterrent. One option, suggested by Victoria Police (personal communication), is to apply components of the penalty structure for hoon drivers and impound a cyclist's bicycle for a nominal period of time. This type of infringement would only apply to cyclists who engaged in unsanctioned racing style riding on public roads as distinct from the 'critical mass' style protest rides.

6.3.1 Idaho style red light yield

Legislation in Idaho permits cyclists to yield at stop signs and signalled intersections without coming to a complete stop (State of Idaho, 2007). While the states of Victoria and Idaho are comparable in geographical size, Victoria's population at 5.2 million (Australian Bureau of Statistics, 2007), is almost four times larger that of Idaho (1.4 million)(U.S. Census Bureau, 2007). The lower population density and greater area of regional spaces is likely to have contributed to Idaho's introduction of such legislation.

This type of legislation is not appropriate in Victoria, and especially not in the metropolitan environment. The inconsistency and subjectivity introduced by changing stop signs and red signals to yields increases the potential for collisions and is not recommended.

6.4 COUNCIL RESPONSIBILITY

The Bayside City Council is the main Victorian council impacted by bunch riding along Beach Road and the council has a bicycle strategy (2003, refer to Section 4.1.1). The council considered a wide range of key issues and identified some potentially effective solutions such as incorporating the needs of cyclists into all road in Bayside, greater promotion of cycling and improving end of trip cycling facilities. While the options to restrict or prohibit vehicle parking on Beach Road during peak cycling times were mentioned, there may be merit in exploring this measure more fully. Restricting vehicle parking has proven controversial, prompting emotive responses from cyclists and residents alike. The request was considered and not approved at a Special Committee meeting of the Bayside City Council in October 2007.

Limiting or prohibiting vehicle parking is an option listed by VicRoads (VicRoads, 2001) as a way of providing on-road space for cyclists. Given that the data analysis in this report found that 23 per cent of cycling collisions involved a parked vehicle, it is probable that there would be safety benefits to cyclists from restricting car parking along Beach Road. A clear passage would minimise cyclists' need to ride in the vehicle lane and provide additional space at narrow sections of road where cyclists are forced to share a single lane with vehicular traffic (Burridge, Lajbcygier and Lema, 2003; O'Connor and Brown, 2007).

Parking restrictions have been implemented along other sections of Beach Road in an effort to improve safety for bunch cyclists. Unfortunately, there has been no published research on the effectiveness of these parking restrictions on safety.

Opposition to the parking restrictions has been voiced by residents of the area. While preparing this report, one author (M. Johnson) was contacted by two residents who had concerns about their safety when crossing Beach Road due to bunch riders and took objection to parking restrictions that would curtail their entitlement to access parking space in front of their homes. It is not known from this communication, or from the Bayside City Council meeting minutes, how representative the views of these two residents are of the wider residential population. The residents concern raises two questions:

1. Are there adequate facilities along Beach Road for pedestrians to cross safely?

2. Are pedestrians exposing themselves to potential collision with cyclists and other traffic by crossing the road outside the pedestrian crossings?

Currently the nature and the extent of residents' concerns regarding cyclists along Beach Road are unknown. Consultation with residents is needed to ensure their views and concerns are part of the decision making process.

6.5 LIMITATIONS

While there was a dramatic difference between the behaviour of the filmed bunch riders in 2007 compared with the 2005 footage, it is unknown if the differences reflect permanent behavioural changes or were in response others factors relevant at the time of the filming. The sets of footage provided by Victoria Police are not directly comparable, with two main limitations, the first related to content and the second to method.

The first limitation relates to the content, in particular the conditions and the type of groups that were filmed. All these factors were so dissimilar that direct comparison was difficult. In 2005, the conditions were dry and clear, in 2007, the conditions were cold and wet. The sizes of the groups varied, the 2005 groups were approximately 100-140 riders and the 2007 groups were much smaller with 30-40 riders. There were also differences in the sections of the route that were filmed. The 2005 footage followed the groups out-bound only, the 2007 included out-bound and in-bound rides. However, none of the footage followed a group the entire return trip making it difficult to identify the route's blackspots.

The second limitation related to the variation in the method of filming. In 2005, the footage was taken at street level with the camera positioned in a vehicle that followed the cyclists and in 2007 the footage was taken from a helicopter. Filming at street levels provides a clear view of the road and is an unobtrusive method that would allow footage to be recorded without the cyclists' knowledge. However this method has limitations, concentrating on the cyclists at the back and the sides of the bunch, giving less information about the riders at the front of the group. In contrast, using a helicopter provides a clear view of the whole group and their interaction with vehicles at all times, however it is an obvious form of observation, cyclists are likely to be aware they are being filmed and this may influence their riding behaviour.

In addition to the technical limitations, there were also situational factors which may have influenced the cyclists' behaviour in the 2007 footage. The timing of the filming coincided with the coronial inquiry into the death of the elderly pedestrian and there was extensive

(negative) coverage of this event by the media, particularly towards the cyclists along Beach Road (Harrison, 2007; Medew, 2007; Oakes, 2007). This attention and the additional Police presence on the day of the filming may well have influenced the cyclists' behaviour in the 2007 footage.

The final limitation relates to the paucity of peer-reviewed literature on bunch cycling. The intention of this review was to determine an evidence-based approach to managing bunch riding issues on Victorian roads based on the published scientific literature. As this evidence is not available, the following conclusions and recommendations have been made.

7. CONCLUSIONS AND RECOMMENDATIONS

The aim of this report was to review the published literature on cycling in large groups or 'bunch riding', in an effort to i) understand the contributing factors to crash and injury risk associated with these groups (including crash and injury risk to other vulnerable road users such as pedestrians as well as to the cyclists themselves), and ii) provide some recommendations for effective enforcement, education and countermeasure strategies.

The research addressing bunch riders has been insufficient to make direct recommendations on how issues related to bunch riding may be managed. The review of Victoria Police footage of the bunch riders showed considerable differences in the cycling behaviour of riders filmed however, it is not known if this is representative of a general and permanent improvement of bunch riders. The elderly pedestrian's death, the associated media attention, the coronial inquiry, Police presence, and timing of filming are all likely to have all been contributing factors to the observed differences in behaviour.

Notwithstanding, based on the findings of this review some broad suggestions for enforcement and education are made to improve the safety of cyclists in general. Furthermore, there is a clear need for further research to address the safety concerns of bunch riding and a number of specific research recommendations are made.

7.1 RECOMMENDATIONS FOR ENFORCEMENT AND EDUCATION

Effective enforcement activities are a vital component of any safety management strategy to deter road users from engaging in risky behaviours. Given the success of Police presence in reducing other unacceptable road behaviours, it is recommended that increased Police presence during peak bunch riding times is considered.

Programs that aim to raise the awareness of safety and promote the adoption of safe cycling behaviours among this group of cyclists are an essential component of any strategy. Continued development and support for community awareness and education campaigns is therefore recommended.

7.2 RECOMMENDATIONS FOR FUTURE RESEARCH

In order to determine the magnitude of the issues at the present time, it is recommended that more research be undertaken to understand the complex issues surrounding attitudes and motivations as well as the behaviour of bunch riders. This could be undertaken by employing a range of methods.

Surveys and focus group sessions are recommended to understand current attitudes and motivations of bunch riders and other cyclist groups.

A series of observational studies are also recommended to determine the current bunch riding behavioural issues in the Melbourne metropolitan area. Specific variables of interest may include exposure data of bunch riders including frequency, number of cyclists, and speed of the bunch including the impact of temporal conditions. This research may be conducted using a number of stationary cameras, positioned at intervals along the route or filming from a vehicle that follows the cyclists. At this stage, further aerial filming is not recommended as it is unknown how the presence of the helicopter influences behaviour. Analysis of the data to determine the characteristics of groups that ride dangerously may also contribute to developing targeted countermeasures.

Future research could also be considered that targets specific issues as follows:

7.2.1 Red light running

Arguably red light running is the most dangerous of unlawful behaviours that bunch riders tend to engage in. When a traffic signal turns red and only part of the group are through the intersection, the remaining riders are reluctant (or unable) to stop and the decision of the individual and the actions of the group are blurred. To avoid this situation O'Connor (2008) suggested that an advanced light signal be installed to warn the cyclists at the front of the group that the signals are about to turn red and that the bunch will not be able to safely cross the intersection (O'Connor, 2008). This places the responsibility of stopping with the front cyclists and removes the excuse that the riders did not know the light was going to change.

It is recommended that a trial of this type of system be undertaken to evaluate its effectiveness in reducing red light running. In addition, consideration of a supporting education and awareness campaign is recommended that aims to increase the front cyclists' understanding of and the purpose/benefits of the advanced warning lights. It is believed that this approach would be accepted by the front cyclists as it contributes to their authority (O'Connor, personal communication). This suggestion is a practical and cost-effective approach to managing red light running, it provides information to cyclists and maintains the decision making process at the front of the group. If the initial exposure research determines that red light running is an ongoing issue with bunch riders, then a trial of this approach is strongly recommended.

7.2.2 Data analysis

An analysis of the available crash and hospital data of cyclists and other road users as it is related to bunch riding would be valuable in determining the extent of the current issue and what changes there have been as a result of the increase in cycling popularity. A comparative analysis of the behaviour of bunch cyclists and single cyclists would also help to determine the behaviours that are specific to bunch riding. This would be useful to determine countermeasure strategies that directly target bunch riders and also establish if bunch riding behaviour is an amplification of how cyclists behave generally or is specific to bunch riders.

7.2.3 Parking restrictions

A review of the effectiveness of existing parking restrictions along Beach Road is recommended. This may include analysis of available crash data, consultation with cyclists, the Council and commercial business owners or residents as appropriate. In the event that these restrictions have been found to provide improvements to safety for cyclists and other vulnerable road users, a trial of similar restrictions is recommended for other sections of Beach Road. Suggestions for the trial include: specific time restrictions for in-bound and out-bound sides of the road, in particular on the narrowest sections of the road and locations of single lane due to road furniture or at corners. Consultation with residents is needed to ensure their views and concerns are part of the decision making process.

7.2.4 Co-ordinated, collaborative approach

It is clear from the limited literature that the main purpose for weekend on-road cycling is training or fitness, this purpose lends itself to bunch riding, sharing the experience with like-minded riders. While externally bunch riding appears unstructured and nebulous, according to the online information (Beach Road Cyclist, 2008) there are specific start times and locations and these unofficial events are regular, organised and occur beyond Beach Road. Although bunch riders are attracted to the lack of 'officialdom' associated with organised cycling clubs (O'Connor and Brown, 2007), a central organisation or register of bunch riding events to ensure the safety and convenience of all road users and that any restrictions to vehicle parking or access is coordinated and adequately publicised.

Victoria has an opportunity to develop best practice approach to managing on-road bunch cycling. It requires a cooperative, collaborative, consultative approach that includes the key stakeholders to ensure the safest environment for all road users. Such stakeholders may include, but are not limited to: formal cycling clubs and informal cycling groups representing individual cyclists, relevant local councils, residents, VicRoads and Victoria Police.

7.2.5 Additional recommendations

In the event that it is determined that there are continuing issues with bunch riders, additional research recommendations include:

- Trial and evaluate a range of deterrent interventions (education and enforcement, including applying hoon legislation)
- Investigate ways to penalise individual unlawful behaviour within a group
- Observation of successful bunch riding groups (e.g. Bendigo) or consultation with key organisers to identify effective strategies
- Experimental work to determine characteristics of a safe bunch including maximum length of group, riding speeds and how the group interacts with other road users
- Trial and evaluation of infrastructure measures that facilitate safe riding.

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